Designing and Optimizing Snake Robot Locomotion

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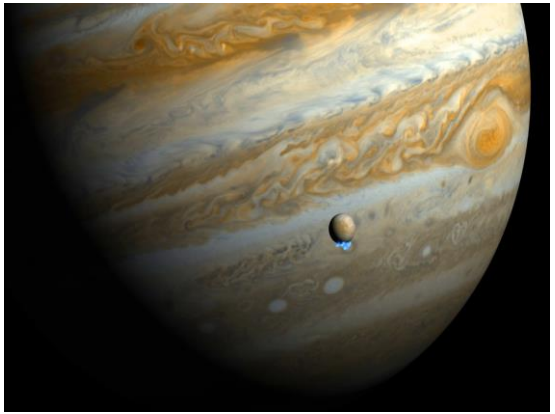
Why building a snake robot matters

Optimizing mobility and autonomy of robots
can supplement or take place of dangerous human jobs

Applications:

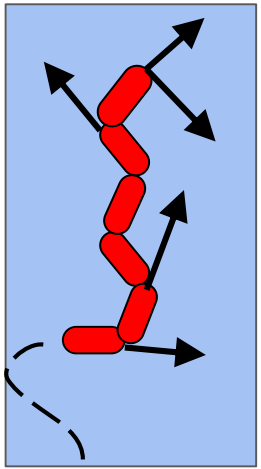
Search and Rescue

Exploration



Roadmap to build a robot snake

Goal 1:
Working Model



Goal 2:
Mimic snake movement

Goal 3:
Optimize speed and energy efficiency

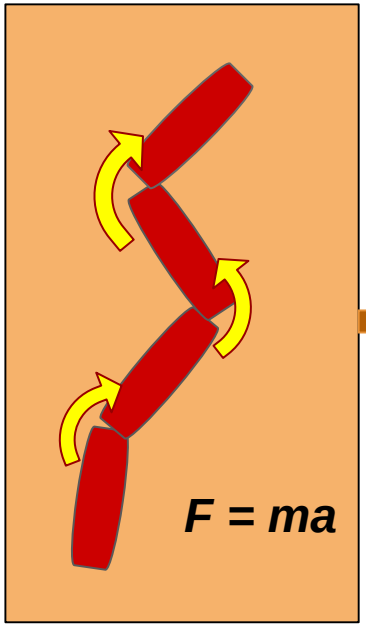
http://clipartfan.com/free-clipart/turtle-fast-speed-clipart-71/

https://www.opuc.texas.gov/energyefficiency.html

→ Versatility and Robustness

Goal 1: Methods to Build Working Model

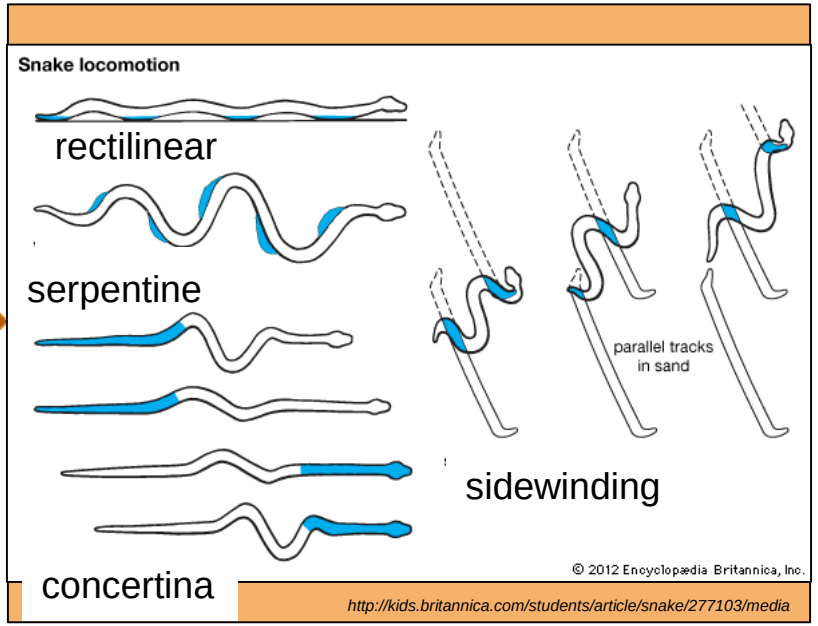
Simulate the kinematics



Develop simulation model

http://www.zfm.ethz.ch/e/dynamics/transeth_leine_snakerobot.htm

Program different motions



http://kids.britannica.com/students/article/snake/277103/media

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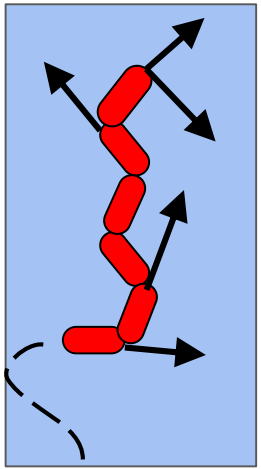

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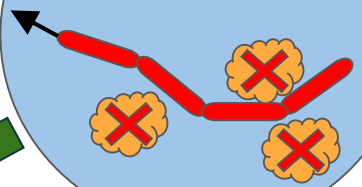
Methodology to Optimize Speed and Efficiency

Fully Optimized

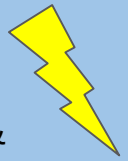
Test a method of locomotion

Observe robot interaction



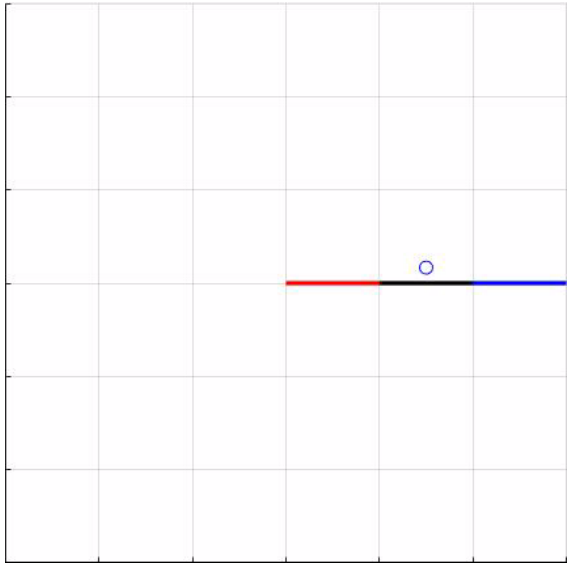
Measure <u>speed</u> and <u>energy consumption</u>

&



Determine improvements

Using Animiations to Determine Simulation Accuracy



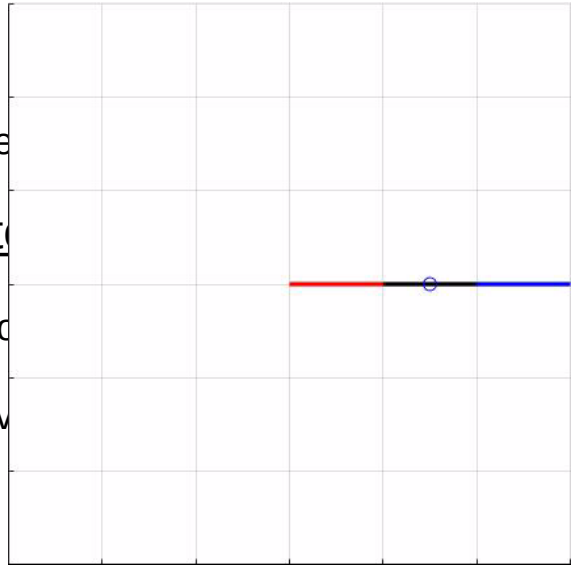
Wrong

In frictionle

Things t

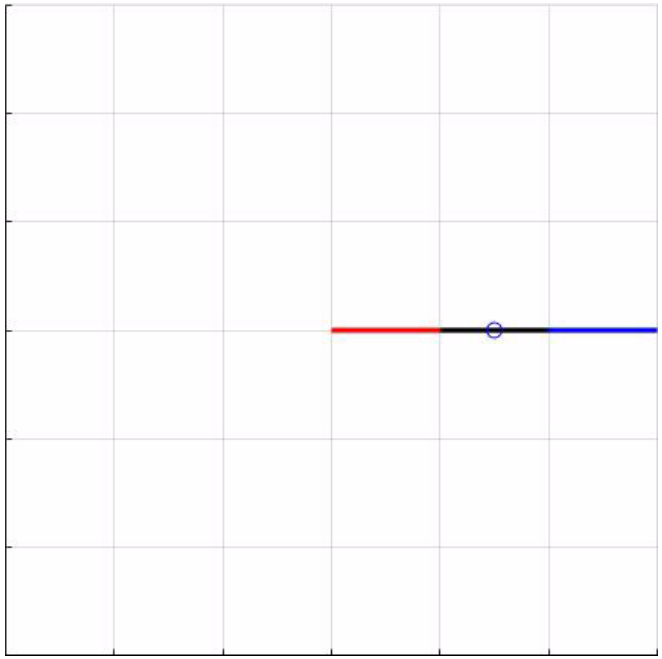
1. Center c

2. Conserv

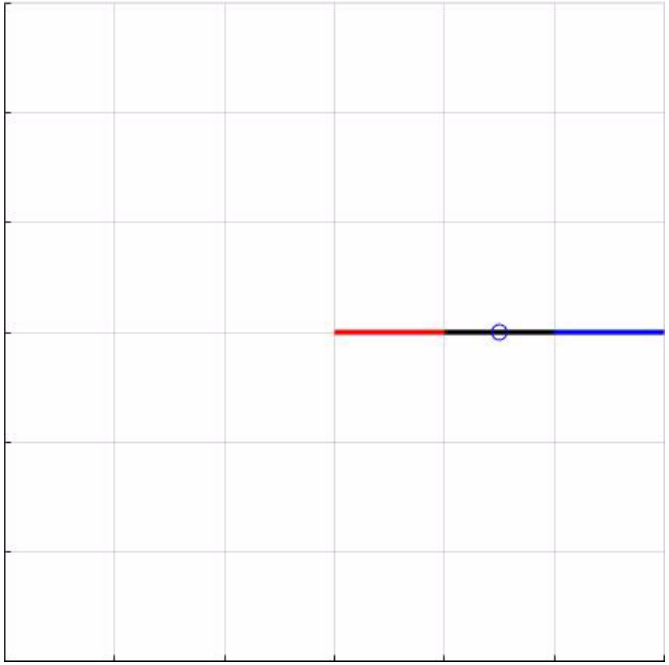


Correct

Exploiting Intermittent Friction to Generate Movement



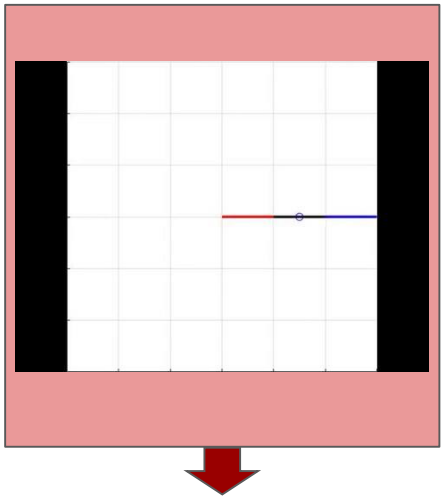
Accordion (Concertina)



Rowboat

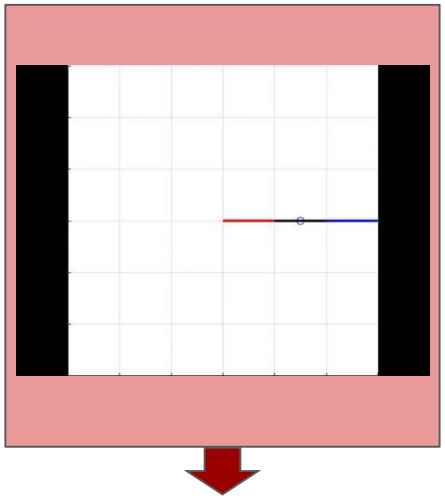
From the preliminary data, a few conclusions can be made

Know simulations are accurate enough



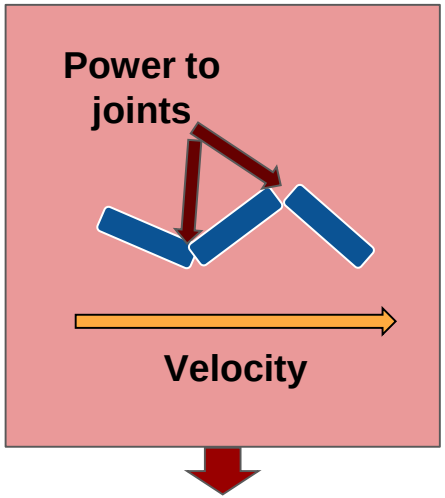
Test optimization parameters confidently

Know friction is suitable in aiding movement



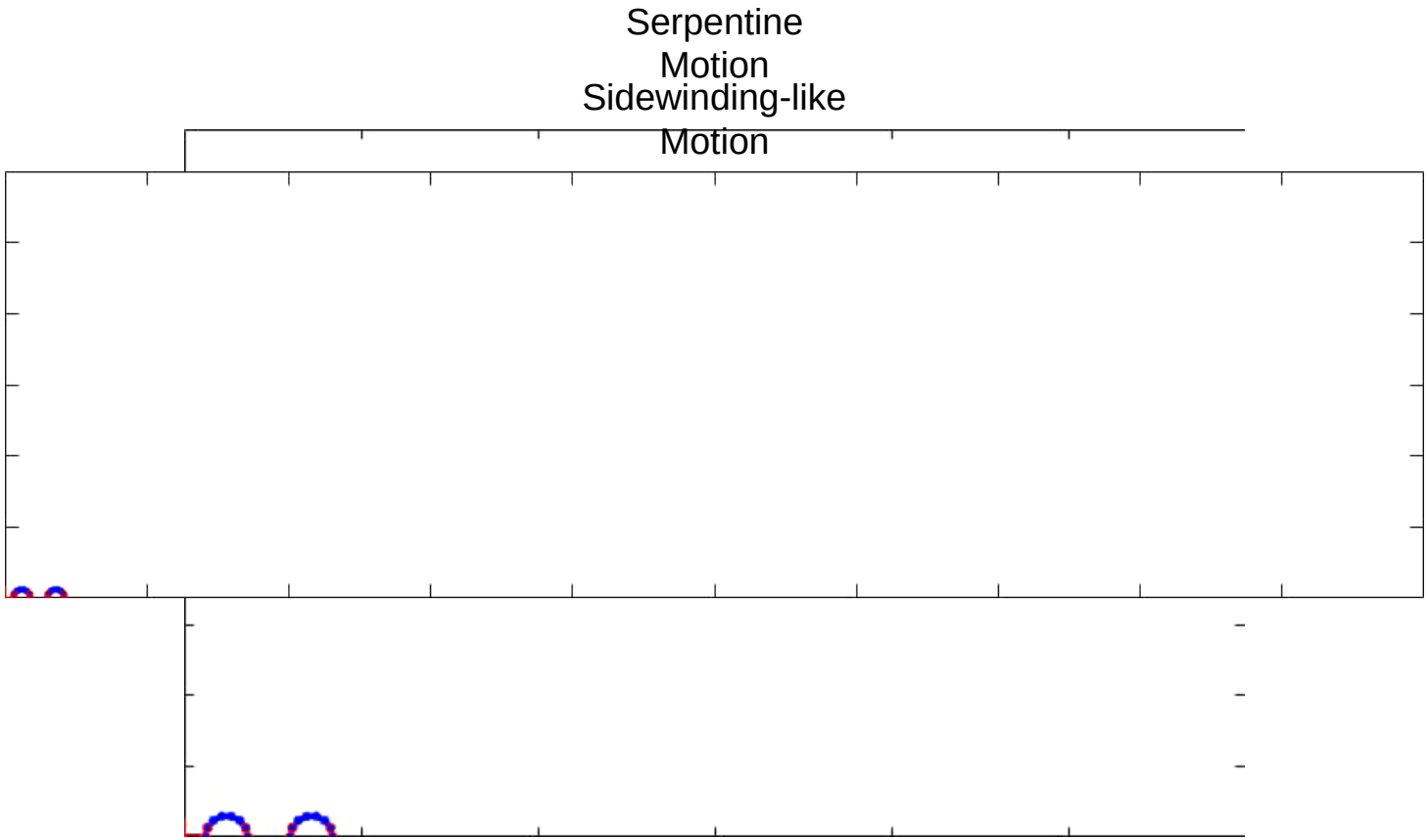
Incorporate asymmetrical friction

Know amount of energy and speed



Find the best solution for any terrain

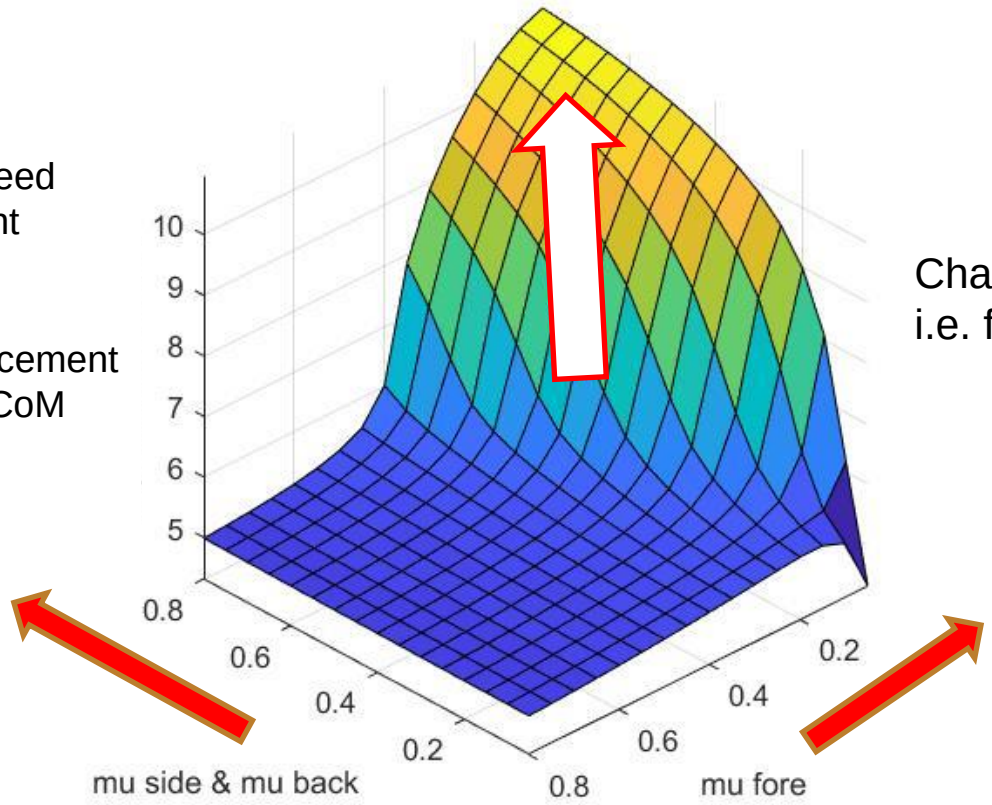
Model Snake Movement using Asymmetrical Friction and Lifting Parts of the Body



Vary parameters that do not inherently increase the amount of power needed to move faster

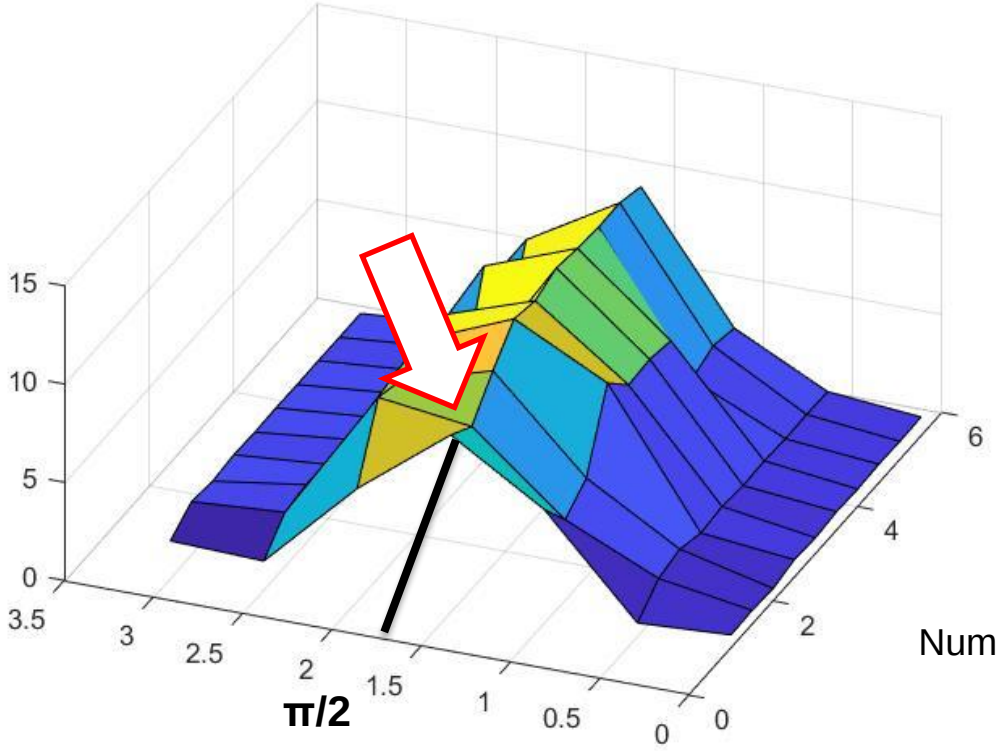
Measurement of speed as time is constant

Displacement of CoM



Change physical properties i.e. friction coefficients

Varying the Location of Pressure Points and Number of Curves on the Snake



Displacement of CoM

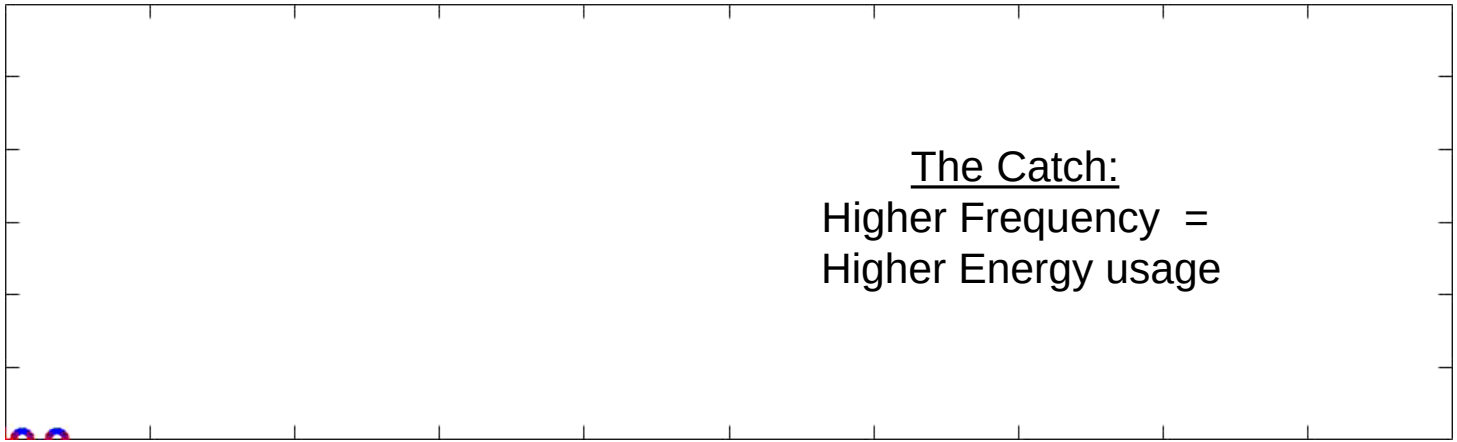
Number of Half Circle Cycles

Location of Pressure Points along curve (In radians)

Frequency of Wave Propagation Leads to Different Methods of Locomotion

Serpentine

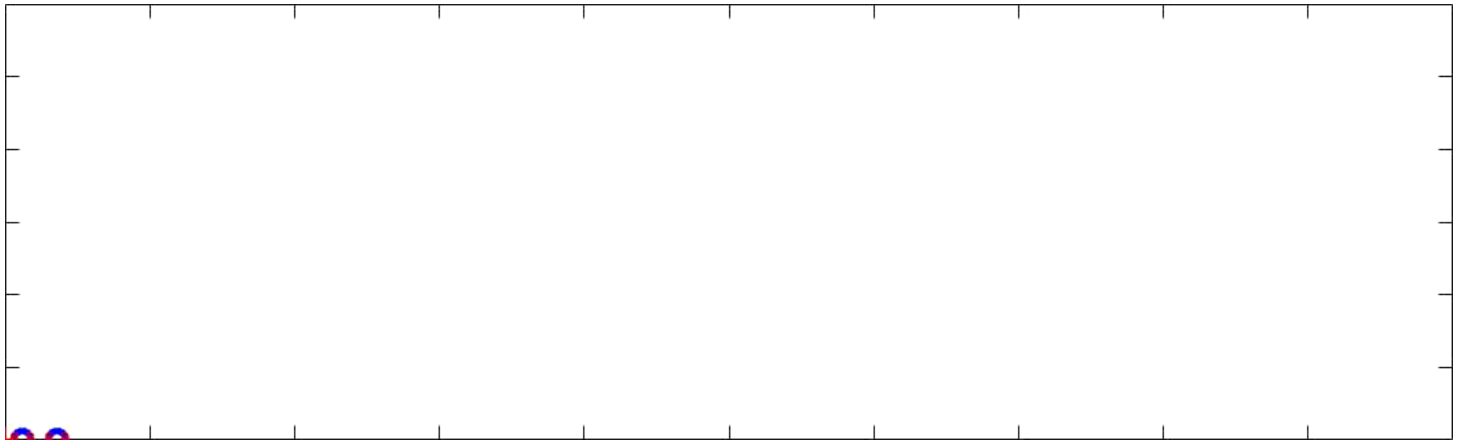
Lower Frequency



The Catch:
Higher Frequency =
Higher Energy usage

Sidewinding

Higher Frequency



Future Goals to Improve the Current Model

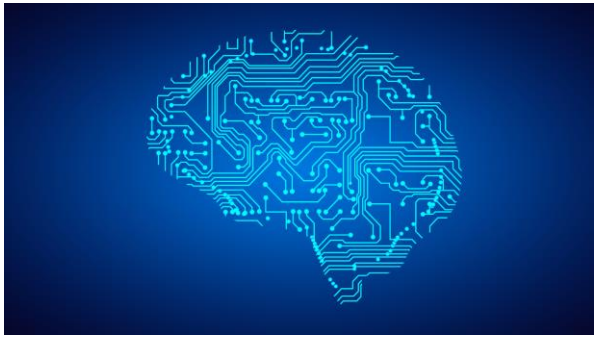
Continue Optimization

http://apps.aria-networks.com/

Incorporate object-aided motion

https://www.rockclimbfairfield.com/

Use machine learning to make robot more <u>autonomous</u>



https://techcrunch.com/2015/11/17/machine-learning-versus-machine-discovery/

Acknowledgements

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